MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2016/2017

TDA3231 – ALGORITHM DESIGN AND ANALYSIS

(All Sections/Groups)

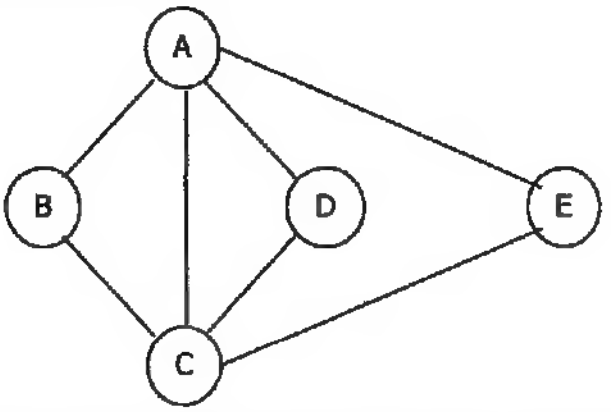
4 March 2017
9.00am – 11.00am
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 4 pages with 4 questions only.
2. Attempt **ALL FOUR** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please write all your answers in the answer booklet provided.

Question 1

The following undirected graph is provided:



(a) Write down its adjacency matrix representation and adjacency list representation. (2 marks)

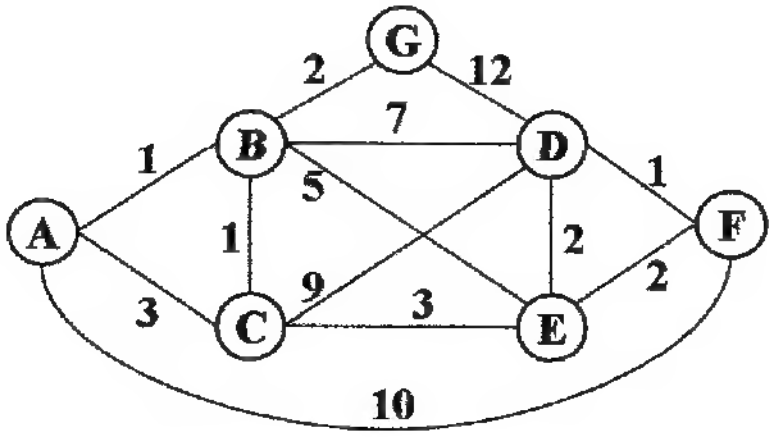
(b) Performing Depth-First-Search (DFS) on a connected graph produces a spanning tree. There are 6 possible spanning trees when we start DFS from B. Draw all the 6 spanning trees. (6 marks)

(c) Performing Breadth-First-Search (BFS) on a connected graph produces a spanning tree. There are 2 possible spanning trees when we start BFS from B. Draw both spanning trees. (2 marks)

Continued....

Question 2

Consider the following undirected, weighted graph:



(a) Step through Dijkstra's algorithm to calculate the single-source shortest path from A to every other vertex. Show your steps in the table below. Cross out old values and write in new ones, from left to right within each cell, as the algorithm proceeds. The values for the first row have been entered for your reference.

Vertex	Known	Distance	Path
A	Y	0	
B			
C			
D			
E			
F			
G			

(6 marks)

(b) List the vertices in the order which you marked them known.

Known vertices (in order marked known): _____ (2 marks)

(c) Indicate the lowest-cost path from node A to node F.

Lowest-cost path from A to F: _____ (2 marks)

Continued....

Question 3

(a) Explain, in general terms, the main differences between the divide-and-conquer technique and dynamic programming. (2 marks)

(b) The following MergeSort algorithm is given. Provide an analysis of its time complexity.

```
Input Parameters: array a, start index p, end index r.
Output Parameter: array a sorted.
Mergesort (a, p, r) {
  // stop if only one element.
  if (p < r)
    // Divide: divide a into two nearly equal parts.
    m = (p + r) / 2
    // Recur: sort each half.
    Mergesort (a, p, m)
    Mergesort (a, m + 1, r)
    // Conquer: merge the two sorted halves.
    Merge (a, p, m, r)
}
```

(4 marks)

(c) Solve the following Knapsack problem. An item must be taken as a whole (taking an item partially is not allowed).

You have a boat that can carry maximum 12 kg of load. The following items are available for your selection. Find the maximum benefit you can obtain by filling out the table below. The values for the first three rows have been entered for your reference.

Item no.	1	2	3	4	5	6
Weight (kg)	6	4	3	5	5	4
Benefit (RM)	60	20	45	10	45	80

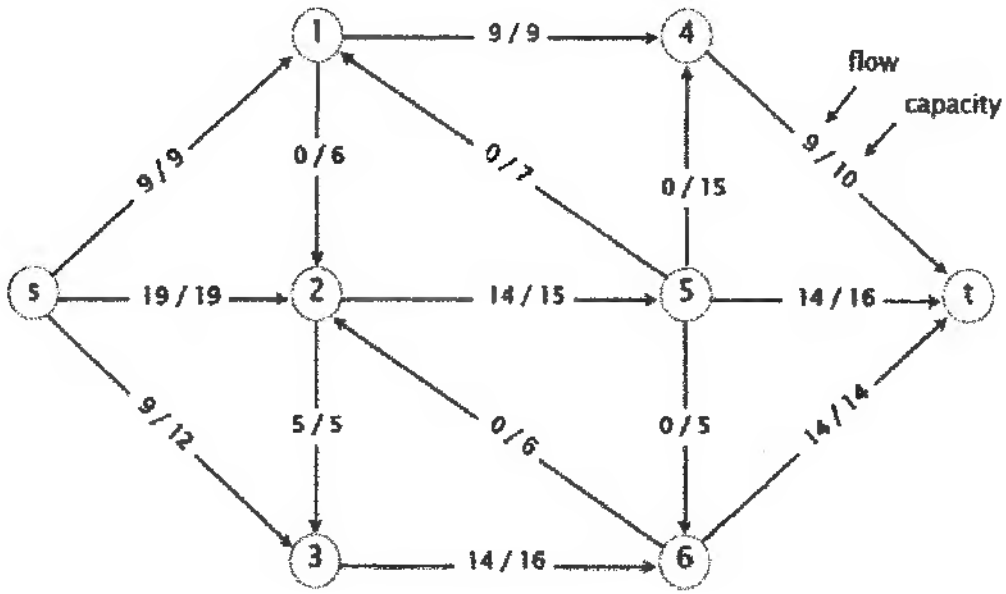
Item	W												
	0	1	2	3	4	5	6	7	8	9	10	11	12
k = 0 {}	0	0	0	0	0	0	0	0	0	0	0	0	0
k = 1 {1}	0	0	0	0	0	0	60	60	60	60	60	60	60
k = 2 {1..2}	0	0	0	0	20	20	60	60	60	60	80	80	80
k = 3 {1..3}													
k = 4 {1..4}													
k = 5 {1..5}													
k = 6 {1..6}													

(4 marks)

Continued....

Question 4

(a) *The following directed graph which represents a st-flow network* (i.e., flow from source *s* to sink *t*) is provided:



(i) With the given flow and capacity values in the above network, what is the total value of the flow at the sink *t*? (1 mark)

(ii) Apply Ford-Fulkerson algorithm, from *s* to *t*, on the above network. List all the possible augmenting paths. Each path is represented as a sequence of vertices. (4 marks)

(iii) What is the value of the maximum flow? (2 marks)

(b) In the context of computational complexity theory, what are the differences between NP, NP-Complete, and NP-Hard? (3 marks)

End of Paper